Report for 2004NV65B: Small Scale Variability of Soil Ped Hydraulic Properties: Potential Impact on Soil Recharge and Ecosystems

- Conference Proceedings:
  - Meadows, D.G., M.H. Young, E.V. McDonald. 2004. Hydraulic properties of individual soil peds, Mojave Desert, CA. Soil Science Society of America 68th Annual Meeting, Seattle, WA, Oct. 31-Nov. 4, 2004.
  - Young, M.H., D.G. Meadows, D. Gimenez, R.J. Heck, T.R. Elliot. 2004. Dynamic behavior of pore morphology using CT scanning preliminary results. Soil Science Society of America 68th Annual Meeting, Seattle, WA, Oct. 31-Nov. 4, 2004.
  - Prim, P.S., D.G. Meadows, M.H. Young. 2004. Determination of interped flow and surface sealing through infiltration experiments on a 100 kA desert pavement. Geological Society of America Annual Meeting, Denver, CO, Nov. 7-10, 2004.
- Other Publications:
  - Meadows, D.G., M.H. Young, E.V. McDonald. 2005. Hydraulic property determination of vesiculated soil peds in desert pavement environments. W-188 Soil Physics Research Group Meeting. Las Vegas, NV, Jan. 3-5, 2005.
- Articles in Refereed Scientific Journals:
  - Meadows, D.G., M.H. Young, E.V. McDonald. 2005. A laboratory method for determining the unsaturated hydraulic properties of soil peds. Soil Sci. Soc. Am. J. 69:807-815.

Report Follows

Problem and research objectives

Spatial variability of soil properties has significant impacts on desert ecosystems that are highly water limited. Coupling that observation with the fact that the southwestern United States has been experiencing significant drought conditions for the past several years, we are left with the need to better understand how water moves through the upper soil surface and into the deeper horizons, particularly in highly structured desert pavement environments. These surfaces are common throughout the arid southwestern United States. Understanding the evolution of the hydraulic properties of these surfaces that result from the pedologic development over time has implications for the mechanisms, frequency, and depth of recharge events, and how those events could influence plant ecosystems, deeper soil recharge, and potential recharge to groundwater supplies.

Methodology

In this study, we compare the hydraulic properties derived from tension infiltrometer experiments conducted in the field with the average hydraulic properties of the individual soil peds that comprised the area of the field experiment. This approach facilitates investigation of the interped cracks that separate the individual soil peds on the soil surface. The field infiltrometer samples both ped and interped areas, and the laboratory method samples only the peds themselves. Therefore, the method provides a means to quantify the potential water flow through these preferential flow pathways. The laboratory method for determining the hydraulic properties of individual soil peds is novel and is based on traditional evaporation experiments. Experiments were conducted on three different aged desert pavement surfaces in the Mojave Desert.

Principal findings and significance

We developed a new laboratory method for determining the hydraulic properties of individual soil peds (Meadows et al., 2005). We show a large amount (2 orders of magnitude) of interped variability in the hydraulic properties over 20 cm. We also show that infiltration into the soil is dominated by the interped cracks on the older surfaces when conditions are near saturation. These interped cracks could act as preferential flow pathways, increasing deep percolation and potential recharge. A transition in the dominant mechanism of infiltration appears to vary with the age of the surface. For example, as the surface ages, the interped area becomes more defined, changing the hydraulic properties of the bulk soil. This is likely caused by an increase in the clay content (perhaps eolian deposited but also weathered from parent material), which causes an increase in shrink/swell activity. Work is continuing to more fully explain these preliminary findings.